in the atmosphere, while only insignificant amounts are ever found, under natural conditions, near the earth's surface. The total amount present over any region can be measured, since the ozone absorbs sunlight of certain wave lengths and the amount of absorption can be determined with the spectroscope. On an average, it is found that the amount of this gas is such that, if it were under a pressure of one atmosphere and at a temperature of 32° Fahrenheit, it would make a layer about 0.12 inch thick. The actual amount is, in general, much greater in high latitudes than in low latitudes, and outside of the Tropics it is subject to rather wide variations, some of which appear to be connected with weather changes and have been the subject of much discussion.

A number of recent measurements have been made of the height of the "ozone layer" in the atmosphere. The method consists of measuring the absorption of sunlight due to ozone both when the sun is high and when it is low. The amount of absorption will vary with the length of the sunlight's path through the absorbing layer. When the sun is high the length of path through the layer will be the same whether the layer is high or low. When the sun is low (i. e., near sunrise or sunset), the path through the ozone layer will, on account of the curvature of this layer conforming to that of the earth, be longer if the layer is low than if it is high.

These measurements indicate that the average height of the ozone layer is between 25 and 30 miles. There is some evidence that its height varies, to a certain extent, with seasons and otherwise.

551.54 (048)

Is the semidiurnal barometric variation an electric phenomenon?—Prof. Fernando Sanford, in an article with the above title in Science, April 19, 1929, suggests that there is a very important relationship between the semidiurnal barometric variation and the semidiurnal electrometer variation. The method of presentation is graphic, and as the graphs can not be reproduced here, only a brief summary of the conclusions can be given.

Meteorologists have long felt that the 12-hour pressure variation, because it follows true local time, must be caused by some agency that does not affect the other meteorological elements, but hitherto no such agency has been discovered. Experiments with especially insulated electrometers have shown that "any insulated, unelectrified body near the surface of the earth, even if inside a closed hollow conductor, will be attracted twice daily by the electric charge of the earth, and it has seemed possible that the semidiurnal variation in barometric pressure may be due in some manner to this attraction. To test this surmise the diurnal variation in pressure as shown by the microbarograph was measured and recorded for the same 20 days for which the electrometer deflections were recorded." A graph of the two curves shows a considerable similarity between them.

"One thing that seems certain," says Professor Sanford, "is that the semidiurnal barometric variation is caused in some manner by solar influence. This is shown by both its daily and seasonal variations. Also the semidiurnal electrometer deflection must be due to the sun, as it has both a daily and a seasonal variation, being of greatest amplitude at the equinoxes and least at the solstices. In this respect it agrees closely with the semidiurnal curve. * * *

"There seems to be no reasonable doubt that the cause of the electropositive condition of the earth and the electronegative condition on the night side are due to the electrostatic induction of the sun's negative charge."—*N. H. B.*

551.513 (048)

Investigation of the oscillations of the general circulation (conclusion)[1]—*By A. Wagner, Innsbruck, Austria.*—The decades 1886–1895 and 1911–1920 were investigated with relation to change in the distribution of the different meteorological elements over the whole earth. These changes, represented in five charts, show the following:

1. The contrasts in air pressure, as they appear from the distribution of mean values over the earth's surface, are heightened in the latter decade. This leads to the conclusion of a uniform intensification in the general circulation. The cause thereof is most probably the greater permeability of the atmosphere for short-wave radiations in the decade 1911–1920 (fewer eruptions of ash, etc., by volcanoes).

2. Coincident with the intensification in the general circulation was a rise of about 3° C. in the mean temperature of the land surface and the continental shelves in agreement with the theoretical judgment of A. Defant. On the other hand, the surface of the deep sea probably became generally colder; the increased intermixing of the water surface, which parallels the intensification of the general circulation, is to be viewed as the cause of this.

3. Outside of narrowly limited regions with opposite anomaly, for which an explanation is found in local influences, the amplitude of yearly temperature became greater in the equatorial zone but smaller in the extratropical regions. The condition for the limiting line of this zone is the relation: Yearly oscillation of insolation = yearly oscillation of outward radiation. On account of the heat of vaporization (of water) the width of this equatorial becomes smaller, especially over the seas, in agreement with the facts of observation.

4. Apart from some local exceptions, the phase of the yearly temperature march was retarded in a wide equatorial zone and advanced in the extratropical regions; the limiting line is given by the condition: Mean insolation = mean outward radiation. Here, too, on account of the heat of vaporization the width of this equatorial zone becomes smaller; from observations there are found as the mean latitudes of this limitation the parallels of 35° N. and 32° S.

5. Just as the pressure contrasts have heightened, so have the contrasts in the distribution of precipitation been increased; increased precipitation in the zone of equatorial calms, diminished precipitation in the horse latitudes, and heavier precipitation in the higher latitudes having west wind drift.

The well-outlined relations between the force of the general circulation and the distribution of the several meteorological elements give a very clear and connected picture that is readily understandable from a physical viewpoint. In the study of these results and in the attempt to explain the different attendant phenomena in a consistent physical manner with relation to the general circulation, there arose a series of related problems to which I endeavored to find answers that are at least qualitatively correct. However, there yet remain in the locally limited anomalies different uncertainties in the given explanations, and these leave a more detailed local investigation desirable.

6. A whole series of correlation factors already well known is compared with the indications of the charts, and in by far the greater number of cases confirmation is found. The value of these correlation factors for forecasting purposes appears to rest solely on the fact that the general circulation shows a considerable tendency to maintain its condition.

[1] Geografiska Annaler. 1929. Heft I, pp. 80–82.

7. It appears that both the influence of a changed solar constant and also that of the 11-year sun spot period on the distribution of the meteorological elements over the earth can be explained by uniform oscillations of the general circulation. In this it must be assumed, however, that an increased relative sun spot number as well as an increased solar constant corresponds, as the result of the coincident increase in the turbidity of the atmosphere, to a lessened insolation and so to a diminished intensity of the general circulation.

It would be of interest to investigate how the relations change in the course of the seasons. One of my students has nearly completed a paper relative to this matter and has divided the decades used here into summer, winter, and transition seasons. An additional investigation proposes to set forth the transition from monthly means to the decade means taken as a basis here. For this purpose my assistant, E. Ekhart, is studying the decade 1911–1920—for the present the distribution of pressure and precipitation—and with the use of a considerably greater number of stations he is able to determine what departures from the average conditions here given occur in the individual years. The work will appear in a short time in Abhandlungen des Preuss. Meteorol. Institut. A further investigation, that of lustrum values for 1885–1920, is in view, but for this a great amount of calculating must be done.—*Translated by W. W. Reed.*

City air.—"A sermon in soot," by Arnold H. Kegel, M. D., commissioner of health, Chicago, published in The Aerologist (September, 1929, vol. 5, pp. 5–9, 59, 5 ills.), effectively draws attention to the ever-increasing dustiness of city air and its deleterious effect on health. While smoke abatement has reduced the combustible dust in the air and its tarry content, it has not stemmed the increasing dustiness. Sunshine records of January and February, 1915–16 and 1925–26, show a reduction of 12 per cent, which the author ascribes to the greater air pollution in the later year. The health department's dust observations in Chicago show for 20 stations an average of 124.6 tons of insoluble solid matter per square mile per month in 1925, with an extreme maximum of 460 tons per square mile in the loop district one winter month. The minimum was 13.4 tons at an outlying station in October, November, and December. For a rough comparison the dust tonnages of Pittsburgh, 161; Liverpool, 140; Chicago, 124; St. Louis, 93; and Cincinnati, 73, are presented.

The author believes that Pittsburgh's leading position in pneumonia death rate in 1928 is the result of that city's unenviable extreme dustiness. A dweller in the Loop district, Chicago, would inhale a pound and a half of dust in the course of a year, according to Doctor Kegel's computations. At least in the congested districts provision of washed air indoors, where the city dweller spends most of his time, appears essential as an immediate though only partial health measure, while general electrification of transportation and heating may be the only though remote means of reducing atmospheric pollution.—*C. F. B.* 551.509.6 (048)

Attempts to induce rainfall.[1]—The Colony of Hong Kong has suffered from an unprecedented deficiency in rainfall during the 12 months ending June 30, 1929, with consequent distress to the population, owing to water shortage.

Amongst the many suggestions received from the public by the local government was the proposition that powdered kaolin, sprinkled from airplanes above suitable clouds, would induce precipitation; the method was stated to have been employed with sucess in other countries. After discussion with other government officials I made the following recommendation:

> I consider that the experiment might reasonably be attempted once. I have little doubt of its failure, but this avenue of relief may then be considered sufficiently explored and be definitely closed thereafter.

My personal opinion is plainly expressed in the foregoing; had the government refused to countenance the experiment, however, there would have remained a feeling in the public mind that one possible solution of the water problem had not been tried. The experiment was made by the unit of the R. A. F. stationed here, and no precipitation occurred.

The reports in the local press are now being commented upon by journals outside the colony, usually with the implication that this observatory was responsible for the inception and conduct of the experiments. This was not the case: the experiments were authorized by the government to discount any subsequent criticism. No belief in a materially successful result was held by administration or its advisers, including my colleagues and myself.—*C. W. Jeffries.*

Ocean currents the probable cause of the 3-year pressure cycle of the tropical South Pacific.[1]—H. P. Berlage, jr., finds a striking sequence in departures of pressure or temperature across the Pacific Ocean, extending over some months, which he ascribes to the transfer of heat by ocean currents. The region from extreme northern Australia over New Guinea and eastern Java is an active center of high temperature and low pressure, in which the variations in temperature appear to dominate the greater or lesser degree of lowness of the pressure, while immediately outside this active area the pressure variations emanating from the active center dominate the temperature. The compensatory area of high pressure appears to be centered near Easter Island in the eastern South Pacific. The variations in pressure at Port Darwin, representing the Australia-East Indian low, and at Juan Fernandez, in the eastern Pacific high, are practically in opposition, except at the end of the southern winter.

With the changes in pressure at these centers there are corresponding changes in the trade winds and, presumably, in the speeds and temperatures of the ocean currents. There is a well-defined sequence of temperature departures following the extremes of pressure in the north Australian low and the South Pacific high, reaching their maximum phases 2½ months later at Iquique, 4 months later at Malden and Samoa Islands, and 7½ months later at Manila. This progressive sequence is at about 33 miles a day, a rate suggesting strongly the translation of temperature anomalies through the great ocean currents.

There is also a sequence of pressure departures from Juan Fernandez to Port Darwin of one and one-fourth years for the negative departures and one and one-half years for the positive. Furthermore, when the departures at Samoa are the same as at Port Darwin, the temperatures and pressures at Port Darwin hold much the same for some time beyond the period of usual change in the normal 3-year sequence, which is thereby lengthened. The persisting temperature effects of ocean currents seem also to be responsible for the continuance at Port Darwin of plus departures in late winter till midsummer and for the consequent assymetry of the 3-year pressure curve, the fall being more rapid than the

[1] Reprinted from Nature, London, Sept. 28, 1929.

[1] H. P. Berlage, jr., "Uber die Ursache der drei-jahrigen Luftdruckschwankung." Met. Zeits., July, 1929, 46:249–259, 4 figs.